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AUTHOR Joseph, John H.
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ABSTRACT

This study examined the effectiveness of observable visual imagery strategy for the encoding of verbal information with special attention given to the relative effectiveness of the strategy for field-dependent and field-independent learners. The subjects, 54 undergraduate and graduaute students ranging in age from 20 to 54, were randomly assigned to one of three treatment groups: (1) computer-presented text without visuals or rehearsal strategies (control); (2) text accompanied by line drawings presented on a handout; or (3) text with visual imaging tasks corresponding to the line drawings in the second treatment. Learning was measured through four criterion tests--drawing, identification, terminology, and comprehension--which were designed to measure achievement of different objectives, and the effects were measured for subjects identified as field-dependent or field-independent on the basis of the Embedded Figures Test. The total criterion test score means indicated that field-independent subjects benefitted most from presented line drawings and scored markedly lower when required to engage in the observable visual imagery strategy. In contrast, field-dependent subjects scored higher when required to engage in the observable visual imagery rehearsal. Statistical analyses and a list of nine references are appended. (MES)

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Author:

John H. Joseph

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Field-Dependence/Independence and the Mathemagenic Effects of Observable Visual Imagery Rehearsal for Learning from Computer-Presented Text

John H. Joseph
The Pennsylvania State University
Capital College
Middletown, PA 17057

Paper presented at the Annual Convention
Association for Educational Communications and Technology
Research and Theory Division
Atlanta, February 27, 1987

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Field-Dependence/Independence
and the Mathemagenic Effects of Observable
Visual Imagery Rehearsal for Learning
from Computer-Present Text

This study examines the effectiveness of observable visual imagery strategy for encoding of verbal information. Of particular interest is the relative effectiveness of the strategy for field-independent and field-dependent learners.

Much instruction is presented verbally, particularly through text. The increased use of videotext in conjunction with computer-based instruction promises continued and increased reliance on this most efficient medium of instructional communication.

Rothkopf (1) developed the concept of mathemagenic behaviors to describe attending phenomena "that are relevant to the translation of the written stimuli into internal representation." Adjunct questions are frequently cited as an example of a mathemagenic technique to enhance learning from text. Various studies have shown that these mathemagenic techniques improve learning.

A number of authors have cited the important and complex role of visual imagery in learning (Fleming and Hutton (2), Hortin (3), Levin (4), Pavio (5)). Hortin (2) studied the use of imagery to solve verbal problems and found that external representation of thoughts led to increased participation in learning activities. Slee (6) concluded that individual differences interact with the effectiveness of visual imagery strategies, particularly for encoding of visual material. However, she emphasized that visual imagery strategies can play a positive role "in the encoding of verbal material for those individuals capable of generating relational images of words' referents."

The issue of provided versus generated pictures also seems bound to individual differences. Levin and Pressley (7) report conflicting evidence to support

both approaches and conclude "that at least for elementary and junior high school students, imposed pictures are certainly as good as induced images, and in some cases better." They point out that there is not yet evidence to generalize about adults.

The dimension of relative field-dependence has been extensively studied in relation to instructional strategies. This measure of perceptual style is found to correlate generally with intellectual functioning important to learning and instructional strategy. Its relevance to this study is based, at least in part, on the cognitive functioning associated with the generation of visual representations of verbal information. As Witkin, et.al. (8) point out in their manual for the Embedded Figures Test,

> ...the ability to analyze experience and the ability to structure experience are both aspects of increasing articulation. Just as the concept of increasing articulation has been applied to experience of an immediately present stimulus configuration (perception) so may it be applied to experience of symbolic material (thinking).

The purpose of this study is to investigate the effectiveness of observable visual imagery rehearsal as a mathemagenic technique for learning from computer presented text instruction. Learning was measured through criterion tests designed to measure achievement of different specific objectives. The effects were measured for subjects identified as either field-dependent or field-independent.

Procedure

Subjects were 54 college undergraduate and graduate students renging in age from 20 to 54 years. Some subjects were paid $5.00 to participate on a voluntary basis and some participated without pay as part of a course requirement. All subjects were randomly assigned to treatments.

The subjects were divided into two groups on the basis of scores on the Group Embedded Figures Test. For the purposes of this study, "field dependent" scores ranged from 0-10 while "field-independent" scores

ranged from 11-18.

The instructional unit and criterion tests were those developed and used by Dwyer (9). The 2,000 word instructional unit deals with the construction and operation of the heart and is accompanied by 37 visuals which illustrate concepts and relationships for which visualization is likely to be beneficial.

The criterion tests were a drawing test with 18 items and identification, terminology and comprehension tests with 20 items each. Together these four tests constituted a total criterion test. Reliabilities (KR-20) of the individual tests equal or exceed .77. The reliability of the total test is .92. Subjects were administered a pretest to determine their prior knowledge of human physiology.

The three experimental conditions were (1) computer presented text without visuals or rehearsal strategies (control), (2) text accompanied by line drawings presented on a handout and (3) text with visual imaging tasks corresponding to the line drawings in treatment two. Subjects in treatment three were instructed to sketch (roughly and for their own benefit) visual representations of the information presented in each frame. All subjects received the criterion tests immediately following the instruction.

The instruction and tests were administered with IBM Personal Computers using the McGraw-Hill Interactive Course Authoring System.

The analysis involved a two-factor design with repeated measures designated RS9 in (A2 @ B3) @ J4. Random subjects were nested in cells formed by the two factors:

Factor A: Two levels of the cognitive style variable, 1) High, field independent and 2) Low, field dependent;

Factor B: Three levels of the instructional variable, 1) no illustrations or rehearsal strategy (control), 2) line drawings and 3) observable visual imagery rehearsal.

The cells were crossed by Factor J, four levels of the criterion measure; 1) drawing test, 2) identification

test, 3) terminology test and 4) comprehension test.

A separate analysis was conducted for the total test composed of the four subscores.

The library program ANOVR was used for the analysis of variance procedures.

Results and Discussion

The analysis of variance procedures for the four individual tests produced significant (.05) F values for only the field-dependence factor and the repeated measure main effects. The conventional ANOVA summary table is presented in Table 1, attached.

The analysis of variance procedure for the total test scores produced a significant F value for only the field-dependence factor main effect. This ANOVA summary table is presented in Table 2, attached.

Accordingly, no significant differences of interest were found in the analysis of variance. Nevertheless, examination of the means reveals some interesting, if not significant, trends. The means are presented in Figure 3, attached.

As indicated by the total test score means, field-independent subjects benefitted most from presented line drawings and, moreover, scored markedly lower when required to engage in the observable visual imagery strategy.

In contrast, field-dependent subjects scored higher when required to engage in the observable visual imagery rehearsal. This improvement was evidenced in each separate test, except for a slight superiority of the control group in the case of the comprehension test.

Obviously, the results cannot support conclusions about the research question; however the consistent patterns of scores suggests that further investigation with greater control might detect differential benefits of the strategy for learners who differ in field-dependence.

A number of factors could have contributed to the variability of scores and reduced power to detect any differences in the treatments. Practical considerations precluded the use of subjects whose ages and general ability were more homogeneous. Similarly, variance may have resulted from the use of both paid volunteers and subjects required to participate as part of a course. Of course, larger cell sizes would increase power as well; the N of nine in this study was based on a power calculation using a variance derived from an earlier study with a less diverse sample.

Notwithstanding the possibility of undetected differences related to field dependence/independence, the results of this study of adult learners correspond to findings of Levin and Pressley (7) for younger learners, that provided pictures are equally effective as generated pictures.

Table 1. Analysis of Variance, RS9 in (A2 C B3) C J4

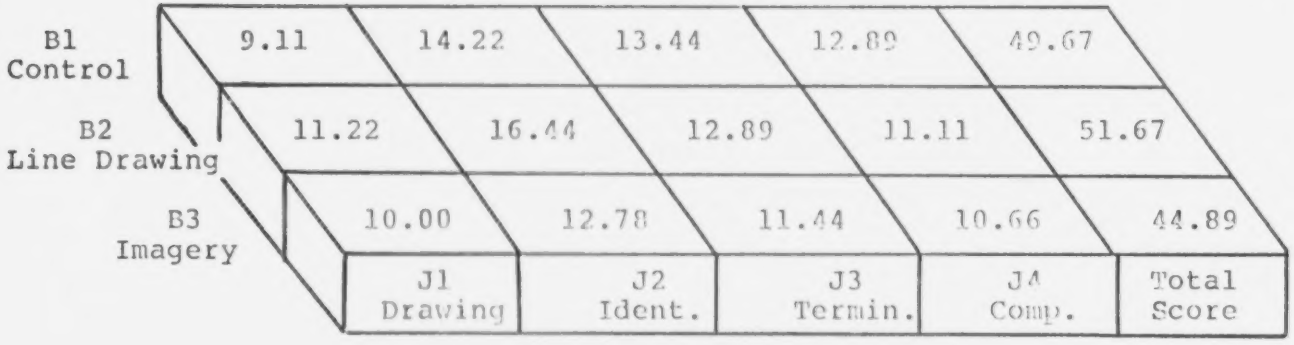
Source	df	Sums of Squares	Mean Squares	F ratio
Between Subjects				
Field-Dependence	1	411.13	411.13	7.766*
Treatments	2	1.36	0.68	0.013
F-D X Treatments	2	86.40	43.20	0.816
Error	48	2540.94	52.94	
Within Subjects				
Criterion Tests	3	386.76	128.92	16.088*
F-D X Tests	3	24.91	8.30	1.036
Treatments X Tests	6	83.49	13.92	1.736
F-D X Tests X Treatments	6	18.90	3.15	0.393
Error	144	1153.94	8.01	

*p < .01

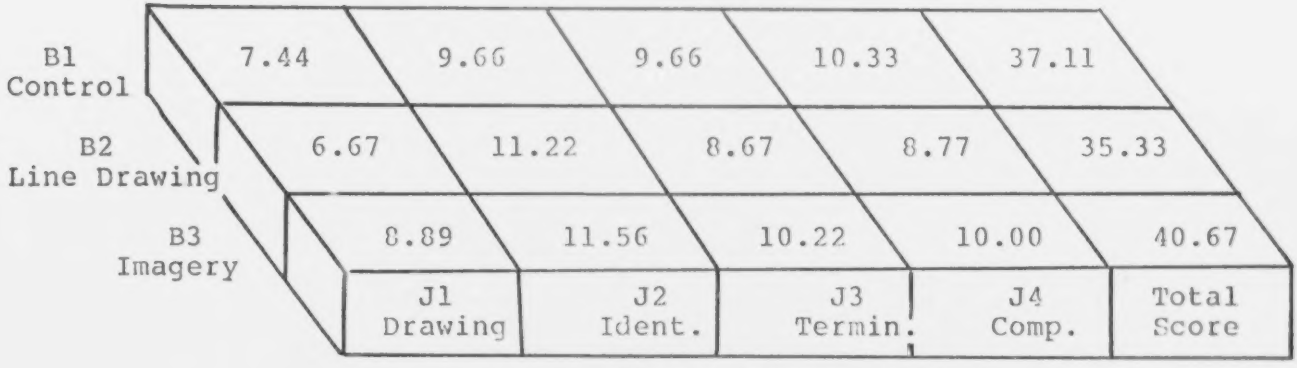
Table 2. Analysis of Variance, RS9 in (A2 ○ B3) - Total Score

Source	df	Sums of Squares	Mean Squares	F ratio
Between Subjects				
Field-Dependence	1	1644.52	1644.52	7.76*
Treatments	2	5.44	2.72	0.01
F-D X Treatments	2	345.59	172.80	0.82
Error	48	10163.78	211.75	

*$p < .01$



A1, Field-Independent



A2, Field-Dependent

Figure 1. Cell Means (N=9)

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